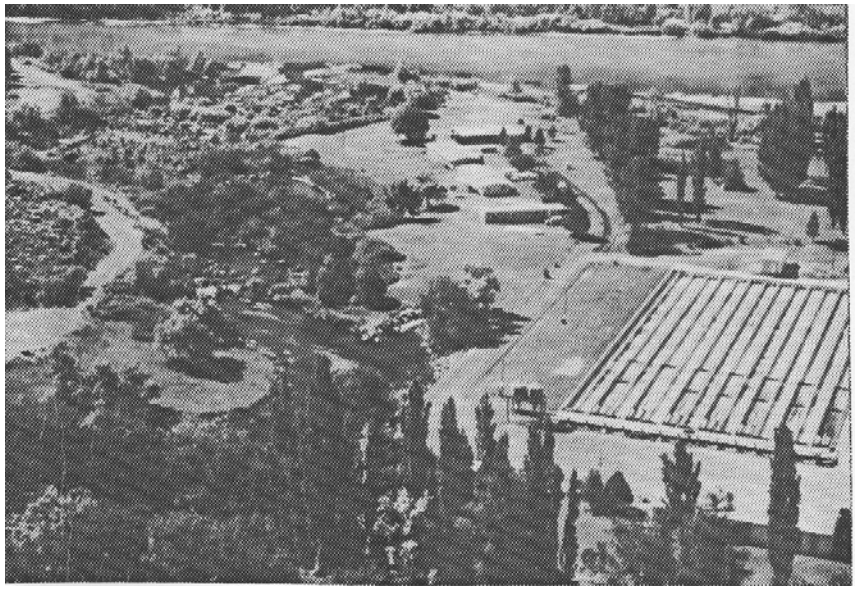
NIAGARA SPRINGS FISH HATCHERY

1996 Steelhead Brood Year Report



by

Jerry Chapman
Fish Hatchery Manager II

Mike Graham
Fish Hatchery Assistant Manager

Russell Wood
Fish Culturist

Tom Tighe
Fish Culturist

IDFG 98-36
September, 1998

TABLE OF CONTENTS

TABLE OF CONTENTS

ABSTRACT

Niagara Springs Fish Hatchery received 2,600,849 steelhead, *Oncorhyncus mykiss,* eggs and fry during the 1996 brood year. A total of 510,000 eggs and 787,250 swimup fry were received from Pahsimeroi and Sawtooth hatcheries, while 520,000 eggs and 783,599 swimup fry were received from Oxbow Hatchery.

Mortalities from pathogens were moderate this year. All steelhead were vaccinated for furunculosis, *Aeromonas salmonicida* and no outbreaks occurred during the year. Some mortalities occurred from coldwater disease, *Flexibacter psychrophilus*, enteric red mouth disease*Yersinia ruckerii*, and *Aeromonas hydrophilia*.

A total of 1,753,653 steelhead smolts (365,920 lb at 4.79 fish/lb) were released into the Snake and Salmon rivers from the period March 24 to April 30, 1997. Additionally, 97,200 fingerlings (3,000 lb at 32.4 fish/lb) were released in American Falls Reservoir on November 26, 1996 and 51,840 fingerlings (1,600 lb at 32.4 fish/lb) were released in Brownlee Reservoir on November 26, 1996. A total of 830,654 smolts of Pahsimeroi stock (179,530 lb at 4.63 fish/lb) were released in the Pahsimeroi River at the weir; 94,815 smolts of Pahsimeroi stock (19,350 lb at 4.90 fish/lb) were released in the Little Salmon River at Hazard Creek; 4,018 smolts of Pahsimeroi stock (820 lb at 4.90 fish/lb) were released in the Salmon River at Hammer Creek; 660,651 smolts of Hells Canyon stock (132,870 lb at 4.97 fish/lb) were released in the Snake River at Hells Canyon Dam; 29,700 smolts of Hells Canyon stock (6,600 lb at 4.50 fish/lb) were released in the Salmon River at Pine Bar Rapids; and 133,815 smolts of Hells Canyon stock (26,750 lb at 4.99 fish/lb) were released in the Salmon River at Hammer Creek.

A total of 421,144 lb of fish feed was fed (104,014 lb of Bioproducts and 317,130 lb of Rangen) at a cost of $174,549.75 to produce 370,520 lb of steelhead for a conversion rate of 1.14:1.

Author:

Jerry Chapman
Fish Hatchery Manager II

Mike Graham
Fish Hatchery Assistant Manager

Russell Wood
Fish Culturist

Tom Tighe
Fish Culturist

INTRODUCTION

Niagara Springs Fish Hatchery (NSFH) is owned and financed by Idaho Power Company (IPC), and operated and staffed by the Idaho Department of Fish and Game (Department). It is located in the Snake River Canyon ten miles south of Wendell, Idaho. The NSFH is one of four hatcheries that IPC owns and Department staffs and operates that fulfill IPC's mitigation requirement under the Federal Energy Regulatory Commission (FERC) license #1971. The goal of NSFH is to rear 400,000 pounds (lb) of steelhead *Oncorhynchus mykiss* smolts annually. Originally, these smolts were used to relocate a portion of the Snake River steelhead run into the Salmon River. Now, 200,000 lb of production is used to enhance the steelhead run below Hells Canyon Dam in the Snake River, and 200,000 lb are stocked in the Salmon River.

OBJECTIVES

The two major mitigation requirements that must be met at IPC's NSFH are to produce quality steelhead smolts to supplement the steelhead trout runs in the Snake River below Hells Canyon Dam and in the Salmon River and its tributaries by successfully meeting these objectives:

1. To rear 200,000 lb of quality steelhead smolts to be released in the Salmon River and its tributaries. The steelhead are to return as adults in sufficient numbers to provide quality sports fisheries in these waters and to supply sufficient brood stock (1,000 adults) to the Pahsimeroi Fish Hatchery for the collection of spawn for the next production cycle.

2. To rear 200,000 lb of quality steelhead smolts to be released in the Snake River below Hells Canyon Dam. These are to return as adults in sufficient numbers to provide a quality sports fishery in the Snake River and to supply sufficient brood stock (1,000 adults) to Hells Canyon Trap for the collection of spawn for the next production cycle.

IDAHO DEPARTMENT OF FISH AND GAME GOALS

1. Provide quality steelhead smolts to the Snake and Salmon rivers that will survive downstream migration and return as adults in sufficient numbers to provide a quality sport fishery in these waters and their tributaries.

2. Provide quality hatchery steelhead for supplementation where wild stocks of steelhead have diminished below desired levels and where managers feel quality hatchery steelhead would enhance the fisheries resource.

3. Enhance the genetic quality of hatchery stocks through management and hatchery practices that favor genetic variability and the wild genetic component.

FACILITY DESCRIPTION

The NSFH facility consists of an indoor nursery area, outdoor rearing raceways, and two flow-through settling ponds. Spring water supplies 19, upwelling incubators and 7, 6 ft diameter, circular tanks (66.5 cubic feet [cf] capacity) and 6, 16 ft rectangular troughs (90 cf capacity) for the hatching and early rearing of fry. The incubators and nursery tanks provide 1,005 cf of hatching and early rearing space.

The outdoor rearing space consists of 19, 300 by 10 ft (142,500 cf) raceway, which are supplied by constant temperature, gravity flow spring water. This allows for the production of 400,000 lb of steelhead to a density index of less than the recommended .35. In addition, the odd numbered raceways are divided in the upper sections into two 4.5 x 20 ft raceways (3,440 cf) for fry and fingerling rearing.

Two flow-through settling ponds (150 ft X 60 ft) have been constructed to remove settleable solids from the NSFH effluent discharge. The settling ponds handle all the flow from the raceways and meet Environmental Protection Act (EPA) guidelines for effluent discharge.

The NSFH feeding system is completely automated. Two moveable bridges span the rearing area. A total of 19 Nielsen automatic feeders are mounted on the bridges. The fish are fed by moving the bridges down the length of the rearing area and energizing the individual feeders on the control panels. Bulk feed is dispensed to the feeders by a conveyor supplied by two, 20,000 lb storage bins with associated fines separator. Nursery areas are fed by Ziegler belt feeders.

Pond cleaning is also automated. An air blower cleaning system has been installed for the raceways. Three blower motors supply approximately 10 psi to the weighted, perforated, airlines on the bottom side corner of each pond. The resulting bubble screen creates a vortex of water currents that keep waste material suspended along the length of the ponds. This system saves many hours of labor sweeping ponds.

A sprayer system was installed to keep depredating birds from eating fish during the rearing cycle. The system is powered by two 15 hp pumps that deliver 292 gpm at 140 ft Total Delivered Head (TDH). The water is delivered to the system from the headrace into two-inch ultraviolet resistant plastic pvc pipe with Rainbird spray nozzles spaced 10 ft apart. The spray system appears to work quite efficiently at keeping birds away. Unfortunately, the spray causes icing on the bridge rails during freezing weather, so that the system cannot be used during the winter months, leaving the fish exposed to heron depredation.

Buildings on the NSFH grounds include four residences (three wood frame houses and a 14-ft wide mobile home); a metal NSFH building (32 ft x 80 ft), containing office, two incubator rooms, garage, shop, and feed storage room; one storage building (10ft x 30 ft); one cinder block chiller building (70 ft x 45 ft) enclosing the chiller, blower-electrical room, heated shop, and garage.

WATER SUPPLY

In addition to NSFH, Niagara Springs supplies water to Rim View Trout Company, Department Niagara Springs Wildlife Management Area, and Idaho State's Pugmire Park. Niagara Springs total flow is 220 cubic feet per second (cfs), which is divided into water rights by the four users. NSFH has a water right of 132 cfs.

Idaho Power Company has entered an agreement with Rim View Trout Company regarding future use of water at Niagara Springs. The five users of Niagara Springs water have signed a stepped agreement whereby NSFH will receive water according to a stepped flow chart (Appendix 1).

Water temperature is a constant 59^{o}F and flows by gravity to feed the incubators, nursery vats, outdoor raceways, fire hydrants, irrigation system, and domestic water system. Water quality is checked on a regular basis at the NSFH (Appendix 2).

Increased demand on the aquifer by agricultural and domestic uses has caused a decline in both quality and quantity of water in the spring. As ground water demands have expanded, the springs have declined by 30% to 40% of historic conditions.

STAFFING

The NSFH is staffed by four permanent and two temporary personnel. The NSFH supervision is handled by a Fish Hatchery Manager II, Jerry Chapman, and Fish Hatchery Assistant Manager, Michael Graham. There are two Fish Culturist, Russ Wood and Tom Tighe, to handle most operational duties. During peak work loads there are two Bioaides, Gene Waltz and Mike Anderson, that assist the permanent staff with culture, maintenance, and other assignments.

FISH PRODUCTION

Egg Shipments and Early Rearing

NSFH received both eggs and fry for the 1996 brood year. Buttoned-up fry were brought in to delay the hatching of early egg takes so that they would mature at the same time as later lots. Early lots of Hells Canyon eggs were held at Oxbow Hatchery in 43^{o}F well water from the end of March until they were shipped to Niagara Springs. The fry were transported in hatching trays in a borrowed two-ton fish truck. The timing of these shipments coincided with the swimup time of the Hells Canyon lots of eggs received at Niagara Springs.

Pahsimeroi eggs were transferred to Sawtooth Fish Hatchery and reared in 41^{o} F well water. Early Pahsimeroi lots 8-14 were shipped in a one-ton fish truck as swimup fry between June 15 to June 22, 1996. These fry were tempered before placing them directly in nursery raceways. Lots 15-24 were received as eggs between June 11 to July 1, 1996.

NSFH received a total 1,303,599 Hells Canyon eggs and fry (520,000 eggs and 783,599 fry) (Appendix 3). Early lots of fry (lots 3-7) were transported in incubator trays from Oxbow Hatchery on June 8 and June 15, 1996, and placed directly in outdoor nursery raceways. Lots 8-11 were shipped as eggs on May 27 and May 31, 1996, and placed in upwelling incubators (65,000 per incubator) in circular vats. Eggs were tempered and disinfected with iodine at 200 ppm for 30

minutes. Once again, several lots of eggs experienced smothering losses as high as 30% at swim up.

Fry were not inventoried from the nursery vats to the nursery raceways this brood year. Consequently, hatching success and mortality could only be estimated. Observation by the NSFH crew showed above normal losses (10%-15%) in the circular vats do to suffocation. Survival of fry to fingerling was 78.2% in the Pahsimeroi steelhead, while survival from fry to fingerling in Hells Canyon steelhead was 83.3%.

Fry and fingerling were fed Bioproducts feed until they reached 15 fish/lb, then they were switched to Rangens extruded 3/32 diet. Fry were started on BioDiet, a semi-moist feed, until they reached 300 fish/lb, then they were switched to BioDry diet. Fry were fed with Ziegler belt feeders in the nursery rearing area until they were given more room (100 ft) and the bridge feeders could be used.

Final Production Rearing

Once the fish outgrow the nursery area, they are moved to 50 ft, then 100 ft, and 200 ft. Next, fin-clipping operations are used to split the fish into even and odd numbered raceways. During this program, fish are crowded to the lower 100 ft section. Half the fish are clipped and put into the upper two thirds of the raceway, while the other half are clipped into the adjacent raceway. Fin-clipping operations started on October 21 and were completed by November 13. Excess fingerlings, surplus to the obligations of the NSFH, were stocked November 26, with 97,200 Hells Canyon fish (3,000 lbs at 32.4 fish/lb) stocked into American Falls Reservoir and 51,840 Hells Canyon fish (1600 lbs at 32.4 fish /lb) stocked into Brownlee Reservoir (Appendix 4).

Fish were given the final 100 feet of rearing space in December. Hells Canyon fish were placed in raceways 1 through 9, while Pahsimeroi fish were placed in raceways 10 through 19. Normal fish culture techniques include feeding fish with the bridge, sweeping raceways, conducting sample counts, cleaning screens, removing mortalities, equipment maintenance, record keeping, and nutrient sampling.

A combination of Bioproducts and Rangen fish foods were fed over the course of the year. A total of 104,014 lb of Bioproducts and 317,130 lb of Rangens was fed for a total of 421,144 lb (Appendix 5). This includes 95,340 lb of oxytetracycline medicated feed. The total cost of the oxytetracycline feed was $50,079.40. The total cost of regular feed was $121,914.45. The total cost for all feed was $174,549.75. The average cost/lb of feed was 41 cents. A total of 370,520 lbs of fish were produced on 421,144 lb of feed for a conversion rate of 1.14:1. Total NSFH production costs were $662,161.05 (includes Idaho Power's expenditures), while the cost/lb of fish produced was $1.79.

Hells Canyon steelhead were kept off feed for 37 days to slow growth rates, while Pahsimeroi steelhead were kept off feed for 55 days. Although early growth rates exceeded 0.33 inches per day, growth rates were slowed to 0.021 inches per day by taking the fish off feed for one week at a time. During the last month, fish were not taken off feed to preserve body fat and reduce stress related to smolting. Oxytetracycline was fed allowing for a 21-day withdrawal time prior to stocking during the final feedings to meet Food and Drug Administration (FDA) requirements.

Fin quality was assessed using the "Ashton Method" of qualitative fin measurement. Fins of steelhead reared at Niagara Springs were compared to fins of wild rainbow trout collected from the Henrys Fork. A total of 100 steelhead from five raceways were analyzed for fin degradation. After measuring the lengths of the dorsal and two pectorals from each fish and comparing the average fin length to the average fork length, fins from fish raised at Niagara Springs were 57.7% of wild fish fins (Appendix 6).

Length frequencies were taken on a regular basis to keep track of variations in fish size and condition factors (Appendix 7). A target guideline of 170 to 220 mm was set by National Marine Fisheries Service (NMFS) biologists to maximize migration and minimize predation by hatchery steelhead on wild salmon. The average length of the fish at release for four raceways on April 8 was 195.0 mm (7.83 inches).

Fish Distribution

Two IPC tanker trucks began transporting steelhead on March 24 and finished on April 30. A total of 72 loads of steelhead (365,920 lb) were transported to the Snake and Salmon rivers (Appendix 4). The first fish were transported to Hells Canyon, then Pine Bar, Hammer Creek, Pahsimeroi, and Hazard Creek (Little Salmon River). Biologists felt that Pahsimeroi fish do better if stocked after the second week in April. Steelhead release figures are as follows: Hells Canyon Dam (Snake River) received 660,651 fish (132,870 lb at 4.97 fish/lb), Pine Bar (Lower Salmon River) received 29,700 fish (6,600 lb at 4.50 fish/lb), Hammer Creek (Lower Salmon) received 137,833 fish (27,570 lb at 4.99 fish/lb), Pahsimeroi River received 830,654 fish (179,530 lb at 4.63 fish/lb) and Hazard Creek (Little Salmon River) received 94,815 fish (19,350 lb at 4.90 fish/lb). In addition to normal stocking, 97,200 surplus Hells Canyon fingerling steelhead (3,000 lb at 32.4 fish/lb) were released to American Falls Reservoir and 51,840 surplus Hells Canyon fingerling steelhead (1600 lb at 32.4 fish/lb) were released into Brownlee Reservoir on November 26. Total survival-to-release was 71.7% for Pahsimeroi steelhead, while total survival-to-release for Hells Canyon steelhead was 74.7%. Total survival to release was 73.2%. Total hatchery production for the year was 370,520 lb, or 1,902,693 fish.

FISH HEALTH

Fish health is always a concern at NSFH. The location of Niagara Springs, in the heart of the commercial trout industry, makes it vulnerable to the horizontal transmission of many etiologic agents. Disease problems from IHNV, IPNV, bacterial furunculosis, *Aeromonas salmonicida*, and bacterial coldwater disease, *Flexibacter psychrophilus,* have caused significant losses in years past (Munson, 1995). Also, the hatchery and spring (water source) are located directly below agricultural land, exposing both to toxic drift and runoff from chemical application to fields above the NSFH. Stringent sanitation programs are implemented to facilitate disease control.

Because furunculosis has been a problem in recent years, all of the fish were vaccinated with an autogenous *Aeromonas salmonicida* bacterin from Aqua Health Limited. These fish were dipped in an oxygenated solution of nine liters of water to one liter of vaccine at a rate of 229 lb of fish per liter of vaccine for 30 seconds.

Mortality for the year was moderate. In October and again in February, minor outbreaks of coldwater disease *Flexibacter psychrophilus* occurred in conjunction with enteric redmouth bacterium (ERM), *Yersinia ruckeri.* Fish were treated for 10 days with oxytetracyline. The outbreak of ERM is the first incidence in several years. Furunculosis was not a problem this year.

The organosomatic index showed normal values in all categories for both Pahsimeroi and Hells Canyon stocks. The mean hematocrit value for Hells Canyon stock was 44.33, while the mean hematocrit value for Pahsimeroi stock was 45.65. The condition of the fish at liberation was the best that pathologist Doug Munson has seen at this facility.

To improve fish health at Niagara Springs, several impediments to fish culture must be corrected. The nursery rearing should be expanded and improved, and the spring intake should be enclosed. Furthermore, a complete exclusion of piscivorous birds from the NSFH would be the best solution to the bird problem at Niagara Springs.

FISH MARKING

Fin Clipping, Coded-Wire Tags, and PIT Tags

All hatchery-reared steelhead in the state are marked with an adipose fin clip. Adipose fin (AD) clipping is done so that fishermen can differentiate between NSFH and wild steelhead. The clipping process also gives the NSFH staff an accurate inventory, since all fish are counted during clipping. Steelhead were clipped at Niagara Springs between October 21 and November 13, 1996.

Brood year 1996 steelhead were coded-wire tagged (CWT) from November 21 to December 10, 1996. Each tag group is held in an individual section so that separate mortality information can be gathered. The CWT groups of 30,000 fish were given a 100 ft section, while CWT groups of 60,000 were given 200 ft of rearing space. The CWT groups of 20,000 were given 60 ft of rearing space. A total of 206,440 CWT fish were released at Hells Canyon Dam, Hammer Creek, Pahsimeroi weir and the Little Salmon River release site (Appendix 8). A total of 61,868 CWT fish (raceways 4 and 6, CWT groups 10-51-01 and 10-52-02) were released at Hells Canyon Dam between March 30 and April 3, while 60,952 CWT fish (raceways 12 and 16, CWT groups 10-51-03, 10-52-03, 10-51-04, and 10-52-04) were released at Pahsimeroi weir between April 15 and April 24, 1997. A total of 61,921 CWT fish (raceway 9, CWT groups 10-52-07, 10-52-08 and 10-52-09) were released at Hammer Creek between April 7 and April 9, and 21,701 CWT fish (raceway 19, CWT group10-51-63) were released at Hazard Creek on April 29 and 30, 1997.

In addition to the CWT fish, 2,000 fish were tagged with Passive Integrated Transponders (PIT) tags on February 27 (raceways 6, 9, 12, and 19) and April 10 and 11, 1997 (raceways 11, 12, 15, and 16). These computer chips are injected into the body cavities of the fish and information can be accessed as to hatchery origin, length, weight, release watershed, date of release, downstream migration, timing and travel rates. In this manner, an individual fish can be traced on its seaward migration without sacrificing the fish. Two separate studies, an annual migration study and a fin quality study were carried out with PIT tags this past year. A total of 1,200 PIT tags in four raceways were used in the annual migration study (Appendix 9). A total of 296 PIT tagged fish were released at Hells Canyon, while 300 PIT tagged fish were released at

Hammer Creek (lower Salmon River). In addition, 300 PIT tagged fish were released at the Pahsimeroi weir (Pahsimeroi River), and 298 PIT tagged fish were released at Hazard Creek (Little Salmon River). The purpose of the fin quality study was to determine if fish with "good" quality fins exhibit differences in downstream migration timing and detection from fish with "bad" quality fins. This study focused exclusively on monitoring timing and interrogation rates between four "good" finned groups and four "bad" finned groups of seaward migrating hatchery steelhead smolts (Curet, 1997). A total of 799 fish were released at Pahsimeroi from four raceways, with 100 "good" finned fish and 100 "bad" finned fish from each raceway (Appendix 10). "Good" fin quality fish had a fin quality greater than 70%, while "bad" fin quality fish had a fin quality less than 35% as measured by the Ashton method (Chapman, 1991). No statistical difference in travel times or interrogation rates was detected between the two groups of fish. The results could have been influenced by high water flows during migration time.

RECOMMENDATIONS

Completed Improvements

Several improvements were completed this past year. The IPC installed an ultrasound water flow-measuring gauge on the discharge pipe from the settling pond. This gauge works in conjunction with the annubar meter on the intake pipe to give accurate flow measurements through the hatchery. Washed river rock was placed in the flowerbeds along the settling ponds and in front of the resident houses. The storage shed, shop area and incubator rooms were insulated and painted. Aluminum dam boards were purchased for the headraces to provide a disease free headrace. A cement pad was poured near the office for the new drinking fountain. Another cement pad was poured over the ultrasound and a new cement park bench was placed on top of it. A cement pad was also placed in front of the new shop door on the west side of the shop. Brush and trees along the road by the IPC park were trimmed and pruned to improve visibility on the road.

Needed Improvements

Early Rearing and Incubation

The circular vats are not adequately designed to safely hatch and rear fry that are required for the station's mitigation. Because of high densities, suffocation occurs when fish are allowed to swim out of incubators and subsequently pile up on the bottom of the circular vats. Density indices exceed .5 when just 100,000 fish hatch and swim into the vats. Consequently, there is no room for growth.

An expansion of the present nursery facility to at least ten times the present size would adequately accommodate early rearing systems. Rectangular nursery raceways should replace the existing circular tanks. The number of raceways should be based on optimum density indices needed to rear fish to a larger size (200 fish/lb or 2.5 inches in length) before moving them to outside raceways. Using these criteria, there should be at least 8,500 cf of rearing space to insure adequate rearing for fry. This system would protect fry from bird predation and provide them with shade from the sun.

Final Rearing

At least one more smolt hauling truck and trailer is needed to ensure that smolts are released in a timely manner. Current hauling procedures require up to 40 days to haul fish to their respective release sites. Optimum release timing for smolts to minimize residualism and maximize downstream survival should involve less than half the 40 hauling days we are currently using.

Employee Safety

The eight-inch wide raceway walls are used as walkways to clean raceways and screens. Walking these walls is a safety problem all year and becomes extremely dangerous in winter. Nonskid walkways need to be installed the full length of the raceway wall to eliminate this hazard. A “trash-rack” needs to be installed in front of the intake gate at the upper pool to prevent access to the spring and injury to the public.

Hatchery Residences

There is a need for one more wood frame house to replace the old trailer. There are four full-time employees at this station and only adequate housing for three. This can be a real hinderance in recruiting employees with families.

Water Source

The water collection box, which supplies water to the incubator rooms, is located near the top of the spring and the amount collected is not enough to safely produce fry. It would seem reasonable to move the collection box to a place in the spring where more water could be collected. However, this is not possible because it would disturb a population of endangered snails and their habitat. Therefore, plans should be developed to tap into the existing pipeline delivering water to the raceways, or the hatchery head pool, as a new supply source.

Building Improvements

A new hatchery and incubation building with functional nursery raceways is badly needed. The building should also include public restrooms that are handicap accessible, office, shop, meeting room, and an adequate feed storage space.

LITERATURE CITED

Chapman, Jerry; Graham, Mike; Wood, Russel; and Jeremy Olson. 1994. Niagara Springs Fish Hatchery 1994 Brood Report. 2131 Niagara Springs Road, Wendell, Idaho.

Chapman, Jerry. 1991. Ashton Hatchery, Resident Hatchery Annual Report.

Curet, Tom. 1997. Effects Of Fin Erosion On Migration Timing And Post Stocking Success Of Hatchery Steelhead Trout. (Unpublished).

Munson, A. D. 1995. Niagara Springs Fish Inspection Report. Department Eagle Fish Health Laboratory. 1800 Trout Road, Eagle, Idaho.

. **APPENDICES**

Appendix 1. Niagara Springs Fish Hatchery monthly water allocations.

Month	Max. Flow	Month	Max. Flow
May	50 cfs	November	70cfs
June	50 cfs	December	90 cfs
July	50 cfs	January	100 cfs
August	50 cfs	February	110 cfs
September	50 cfs	March	120 cfs
October	60 cfs	April	120 cfs

Appendix 2. Niagara Springs Fish Hatchery monthly water allocations.

Analysis	**Results 94 (mg/l)**	**Results 97 (mg/l)**	**Maximum Contamination Levels**
Alkalinity	166.000	145	10.0
Antimony	0.002	0.002	0.006
Arsenic	0.005	N/D*	0.05
Barium	0.180	N/D	1.000
Beryllium	0.0002	N/T*	0.004
Cadmium	0.00034	N/D	0.004
Chromium	0.002	N/D	0.1
Chloride	N/T	11	250
Copper	0.010	N/D	1.3
Cyanide	0.005	N/T	0.200
Fluoride	0.570	0.9	4.0
Hardness	234	130	100
Iron	0.010	N/D	0.3
Lead	0.002	N/D	0.015
Manganese	N/T	N/D	0.05
Mercury	0.0002	N/D	0.002
Nickel	0.003	N/D	0.1
Nitrate as N	1.630	0.9	10
Nitrite as N	0.01	N/D	1.0
PH	8.00	8.4	6.5 - 8.5
Selenium	0.005	N/D	0.05

*N/D Not detected
*N/T Not tested

Appendix 3. Niagara Springs Fish Hatchery steelhead survival from egg to smolt.

Source	Eggs Received	Fry Received	Total Received	Fingerlings Released	% Survival Fingerlings	Smolts Released	Total Release	% Survival To Release
Pahsimeroi	510,000	787,250	1,297,250	0	78.18%	929,487	929,487	71.65%
Oxbow	520,000	783,599	1,303,599	149,040	83.25 %	824,166	973,206	74.66%
Totals	**1,030,000**	**1,570,849**	**2,600,849**	**149,040**	**80.73%**	**1,753,653**	**1,902,693**	**73.16%**

*51,840 Brownlee Reservoir
*97200 American Falls Reservoir

Appendix 4. Niagara Springs Fish Hatchery steelhead distribution.

Destination	Stock	Weight	Dates	Number Per Pound	Number Released
Hells Canyon	H.C.	132,870	3/24-4/5/97	4.97	660,651
Pine Bar	H.C.	6,600	4/6/97	4.50	29,700
Hammer Creek	H.C.	4,200	4/7-4/9/97	5.20	133,815
Hammer Creek	Pah	820	4/9/97	4.90	4,018
Pahsimeroi	Pah	179,530	4/11-4/28/97	4.63	830,654
Hazard Creek (Little Salmon)	Pah	19,350	4/29-4/30/97	4.90	94,815
Total		**365,920**		**4.79**	**1,753,653**
American Falls Reservoir	H.C.	3,000	11,26,96	32.40	97,200
Brownlee Reservoir	H.C.	1,600	11/26/96	32.40	51,840
Total		**4,600**		**32.40**	**149,040**
Total Production(Fingerlings&Smolts)		**370,520**			**1,902,693**

Appendix 5. Niagara Springs Fish Hatchery production costs.

Number of Fish	Lbs of Feed	Cost of Feed	Pounds of Fish	Feed Conversion	Total Cost	Cost per 1,000	Cost per Pound
1,902,693	421,144	$174,549.75	370,520	1.14	662,161.05	348.01	1.79

*Cost includes IPC cost for overhead, smolt hauling and shop expenditures

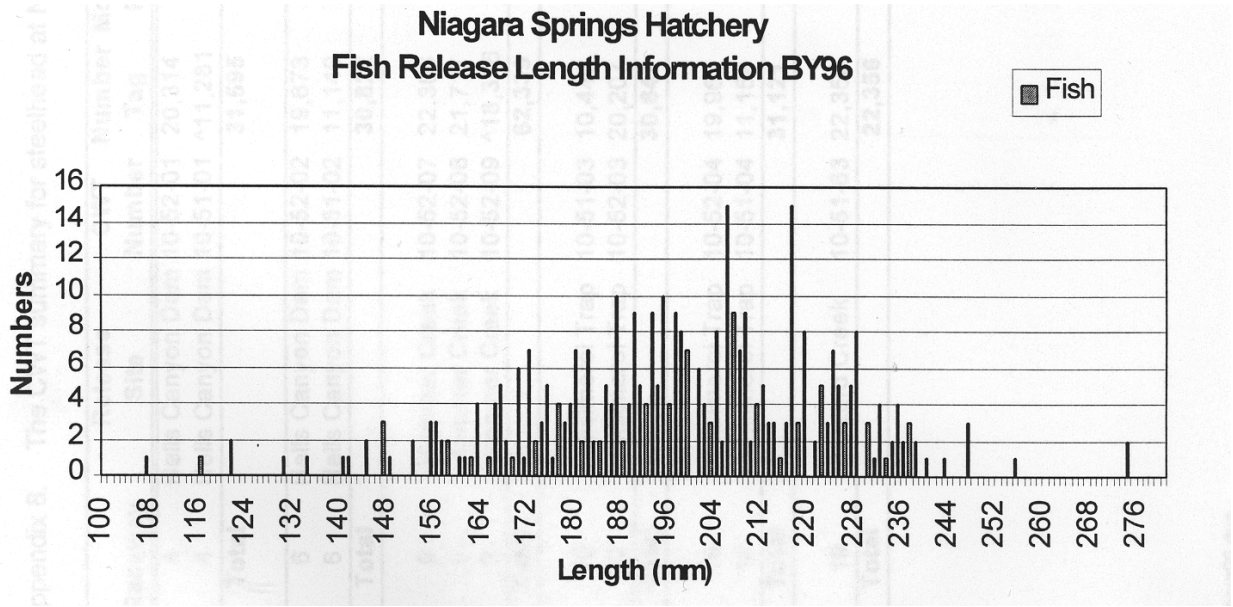
Appendix 6. Fin lengths of Niagara Springs Fish Hatchery steelhead, April 11, 1997.

Raceway	Fork Length	Right Pectoral	Left Pectoral	Dorsal	Ave. Fin Length	Fin Factor
11	212.6	19.7	19.8	13.5	17.7	64
15	193.3	15.3	16.2	8.7	13.4	54
16	195.2	16.8	16.7	8.0	13.8	55
Average	**200.3**	**17.3**	**17.6**	**10.1**	**45.0**	**57.7**

Appendix 7. Length frequencies at release for four raceways, April 11, 1997.

Raceway #	**H.C. 4**	**H.C. 9**	**Pah. 12**	**Pah. 19**
Sample Size	102	106	61	105
Ave. Length	206	195	205	190
Lower Range (mm)	107	116	121	130
Upper Range (mm)	274	240	247	238

	(mm)	(inches)
Hells Canyon Average Length	200.5	7.89
Pahsimeroi Average Length	197.5	7.78
Overall Average Length	**195.0**	**7.83**



Appendix 8. The CWT summary for steelhead at Niagara Springs Fish Hatchery.

Raceway	Release Site	CWT Number	Number Tag	Mortality to Release	Number Shed	CWT Number Released	Untagged	Total Tagged Group Release	Total Site Release
4	Hells Canyon Dam	10-52-01	20,314	145	7	20,162	40,326		
4	Hells Canyon Dam	10-51-01	^11,281	81	4	11,196	22,396		
Total-4			**31,595**	**226**	**11**	**31,358**	**62,722**	**190,055**	**660,651**
6	Hells Canyon Dam	10-52-02	19,673	191	9	19,473	41,788		
6	Hells Canyon Dam	10-51-02	11,149	109	5	11,035	23,679		
Total-6			**30,822**	**300**	**14**	**30,508**	**65,467**	**190,055**	**660,651**
9	Hammer Creek	10-52-07	22,306	143	7	22,156	13,567		
9	Hammer Creek	10-52-08	21,717	139	6	21,572	^13,211		
9	Hammer Creek	10-52-09	^18,316	^118	5	18,193	11,141		
Total-9			**62,339**	**400**	**18**	**61,921**	**37,919**	**99,840**	**137,833**
12	Pahsimeroi Trap	10-51-03	10,440	142	0	10,298	22,841		
12	Pahsimeroi Trap	10-52-03	20,207	275	0	19,932	44,219		
Totals-12			**30,647**	**417**	**0**	**30,230**	**67,060**	**186,120**	**830,654**
16	Pahsimeroi Trap	10-52-04	19,962	248	8	19,706	56,984		
16	Pahsimeroi Trap	10-51-04	11,159	138	5	11,016	31,846		
Totals-16			**31,121**	**386**	**13**	**30,722**	**88,830**	**186,120**	**830,654**
19	Hazard Creek	10-51-63	22,356	621	34	21,701	73.114		
Total-19			**22,356**	**621**	**34**	**21,701**	**73,114**	**94,815**	**94,815**

Total CWT Release	**206,440**
Total Site Release	**1,723,953**
Total Smolt Release	**1,753,653**
Total hatchery Release	**1,902,693**

Appendix 9. The PIT tag summary for steelhead at Niagara Springs Fish Hatchery.

Raceway	Release Site	Number Tagged	Number Released	Mortality
6	Hells Canyon	300	296	4
9	Hammer Creek	300	300	0
12	Pahsimeroi Weir	300	300	0
19	Hazard Creek	300	298	2
Totals		**1,200**	**1,194**	**6**

Fin Study PIT Tags

Raceway	Release Site	Fin Condition	Number Tagged	Number Released
11	Pahsimeroi Weir	bad	100	100
11	Pahsimeroi Weir	good	100	100
12	Pahsimeroi Weir	bad	100	100
12	Pahsimeroi Weir	good	99	99
15	Pahsimeroi Weir	bad	100	100
15	Pahsimeroi Weir	good	100	100
16	Pahsimeroi Weir	bad	100	100
16	Pahsimeroi Weir	good	100	100
Totals			**799**	**799**

Appendix 10. Niagara Springs Fish Hatchery history, BY66 to present.

NIAGARA SPRINGS HATCHERY
HATCHERY HISTORY BY66-PRESENT

YEAR	PAHSIM. EGGS\ FRY RECEIVED	OXBOW EGGS\ FRY RECEIVED	TOTAL EGGS\ FRY RECEIVED	TOTAL YEARLY MORT.	% MORT YEARLY	FALL RELEASES	SALMON R. SMOLT RELEASES	HELLS C. SMOLT RELEASES	SPRING RELEASES	TOTAL LBS RELEASED	FEED FED TOTAL LBS	CONV	FISH/LB
1965-66	0	3,085,194	3,085,194	---	---	---	---	---	---	---	---	---	---
1966-67	0	2,605,288	2,605,288	623,533	23.93	29,400	1,364,842	587,513	1,952,355	153,552	305,890	1.99	12.71
1967-68	0	3,215,652	3,215,652	1,209,183	37.60	0	1,664,325	342,144	2,006,469	204,251	298,450	1.46	9.82
1968-69	0	2,469,536	2,469,536	695,219	28.15	0	1,665,117	109,200	1,774,317	184,186	280,430	1.52	9.63
1969-70	1,477,695	1,927,727	3,405,422	654,022	19.21	757,500	1,608,000	385,900	1,993,900	299,235	502,410	1.68	6.66
1970-71	1,330,494	1,480,150	2,810,644	-305,176	-10.86	670,960	1,630,002	0	2,444,860	202,025	384,040	1.90	12.10
1971-72	1,439,842	700,061	2,139,903	153,603	7.18	215,625	1,555,050	0	1,770,675	235,375	376,080	1.60	7.52
1972-73	8,850,764	1,819,721	10,670,485	3,105,637	29.10	3,008,664	1,543,349	0	4,556,184	163,839	266,800	1.63	27.81
1973-74	3,663,990	1,264,384	4,928,374	2,953,847	59.94	0	1,960,378	0	1,974,527	187,494	319,130	1.70	10.53
1974-75	3,160,144	280,098	3,440,242	2,108,426	61.29	0	1,331,280	0	1,331,816	166,640	352,890	2.12	7.99
1975-76	2,234,978	51,559	2,286,537	513,688	22.47	40,977	1,690,390	0	1,731,872	248,708	437,600	1.76	6.96
1976-77	2,487,824	730,862	3,218,686	1,642,383	51.03	0	1,433,675	141,005	1,576,303	251,835	454,762	1.81	6.26
1977-78	2,540,728	517,250	3,057,978	1,229,537	40.21	281,208	1,266,025	0	1,547,233	154,829	370,080	2.39	9.99
1978-79	2,048,350	441,069	2,489,419	426,977	17.15	344,944	1,372,454	0	1,717,498	244,887	643,680	2.63	7.01
1979-80	2,622,425	124,814	2,747,239	203,985	7.43	548,987	1,097,060	348,220	1,994,267	314,100	629,580	2.00	6.35
1980-81	1,697,010	498,416	2,195,426	720,172	32.80	0	862,494	612,760	1,475,254	316,330	622,930	1.97	4.66
1981-82	2,003,418	298,952	2,302,370	953,015	41.39	0	995,205	354,150	1,349,355	374,350	663,850	1.77	3.60
1982-83	2,313,339	253,776	2,567,115	1,431,975	55.78	500,000	542,390	92,750	635,140	181,150	448,860	2.48	3.51
1983-84	2,749,292	709,716	3,459,008	1,849,313	53.46	449,070	752,195	408,430	1,160,625	310,000	632,400	2.04	3.74
1984-85	2,333,760	598,404	2,932,164	613,771	20.93	630,500	1,273,181	414,712	1,687,893	314,650	541,198	1.72	5.36
1985-86	1,332,152	1,582,340	2,914,492	903,999	31.02	330,640	860,358	819,495	1,679,853	339,885	580,850	1.71	4.94
1986-87	1,339,176	935,195	2,274,371	422,476	18.58	39,995	1,011,900	800,000	1,811,900	419,000	557,960	1.33	4.32
1987-88	1,640,040	1,289,029	2,929,069	775,569	26.48	404,000	872,100	877,400	1,749,500	405,515	584,290	1.44	4.31
1988-89	1,256,289	1,213,399	2,469,688	803,488	32.53	0	930,700	735,500	1,666,200	406,800	574,770	1.41	4.10
1989-90	1,925,795	833,397	2,759,192	252,892	9.17	603,000	956,100	947,200	1,903,300	465,400	597,310	1.25	4.09
1990-91	1,966,434	113,190	2,079,624	311,624	14.98	0	856,000	912,000	1,768,000	484,025	632,030	1.28	3.65
1991-92	650,400	691,500	1,341,900	311,400	23.21	0	786,600	243,900	1,030,500	232,500	283,000	1.22	4.43
	Wallowa	812,000	812,00	394,936	48.64	0		417,064	417,064	72,786			5.73
1992-93	1,131,951	1,013,846	2,145,797				761,800	353,600		235,075			
1992-93	Babington's	*Babington's released Little Salmon					*222,560	306,907	**47,089	131,090			
		**Brownlee Reservoir											
1993-94	954,294	1,509,596	2,463,890	1,263,820	54.89	0	928,981	609,115	1,538,096	350,151	440,143	1.26	4.40
1994-95	1,042,728	1,099,915	2,142,643	281,034	13	160,000	741,180	960,429	1,701,609	376,060	489,960	1.29	4.52
1995-96	1,400,000	1,397,103	2,797,103	906,008	32.4	157,600	890,135	843,360	1,733,495	352,750	429,528	1.22	5.00
1996-97	1,297,250	1,303,599	2,600,849	698,156	26.84	149,040	1,093,002	660,651	1,753,653	370,520	421,144	1.14	4.79

Submitted by:

Jerry Chapman
Fish Hatcheries Manager II

Mike Graham
Fish Hatchery Assistant Manager

Russell Wood
Fish Culturist

Jeremy Olson
Fish Culturist

Approved by:

Virgil K. Moore, Chief
Bureau of Fisheries

Tom Rogers
Fish Hatcheries Supervisor